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(19) (CA) **CANADIAN PATENT** (12)

(54) Building Brick and Method and Apparatus for Notaring

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This invention relates to a building brick and more particularly it relates to an improved self aligning building brick.

Self aligning building bricks are known, as shown in U.S. patent No. 4,124,961 issued to Carl Habegger. Such building bricks may easily be laid by an unskilled person and provide a strong structural joint between adjacent bricks. However flow-through mortaring of the bricks has proven difficult in practice.

It is therefore an object of the present invention to provide a self aligning building brick in which flow-through mortaring of a wall or other structure formed from the bricks can more easily be achieved. It is also an object of the invention to provide an improved method for mortaring bricks, and an improved device for accomplishing such mortaring.

In one of its aspects the present invention provides a building brick having:

(a) upper and lower faces,

(b) first and second end faces,

(c) first and second side faces,

(d) said upper face having a pair of parallel upstanding ridges one adjacent each side of said brick and each ridge extending substantially the entire length of said brick, said upper face having a first recessed portion between said ridges, said first recessed portion extending substantially the entire length of said brick,

(e) each ridge being substantially triangular in form, having an outer surface which slopes steeply in a direction toward its adjacent side face and towards said bottom face to form, when one brick is placed atop another, an edge recess extending along each side of the join between adjacent said bricks, each ridge also having a narrow flat apex surface, and an inner surface which slopes steeply laterally inwardly toward said recessed portion,

(f) said lower face having a pair of narrow flat edge surfaces one at each side of said brick and extending substantially the entire length of said brick, a pair of sloping surfaces sloping upwardly from said edge surfaces, and a flat recessed surface joining said sloping surfaces to form a second recessed portion, said second recessed portion extending substantially the entire length of said brick,

(g) said second recessed portion and said ridges being complementary in location so that when one brick is placed atop another, said sloping surfaces of said second recessed portion lie over said outer surfaces of said ridges to align said side faces of said bricks and to restrain sideways movement of one of said bricks relative to the other, and said flat recessed surface of said second recessed portion rests on said flat apex surfaces thereby carrying the weight of the

upper brick, said flat recessed surface and said second recessed portion defining a horizontal space between said bricks,

(h) said brick having an enlarged vertical hole extending between said upper and lower faces, each end face having a pair of projecting vertical edge portions, one adjacent each edge of said brick and extending substantially the entire height of said brick, so that when two bricks are placed end to end, said edge portions lie sealingly against each other,

(i) each end face of said brick having an enlarged end recess therein extending substantially the entire height of said end face, said end recess being substantially of the same width as that of said vertical hole and being substantially half the length of said vertical hole so that when two bricks are placed end to end, the two recesses in said

end faces are aligned and form a vertical opening of substantially the same dimensions as said vertical hole,

(j) said vertical hole and said recessed portions are tapered vertically to facilitate removal of said brick from a mold.

In another aspect the invention provides a method of building a wall comprising:

(a) stacking a plurality of bricks to form said wall, each brick comprising:

(i) upper and lower faces,

(ii) first and second end faces,

(iii) first and second side faces,

(iv) said upper face having a pair of parallel upstanding ridges one adjacent each side of said brick and each ridge extending substantially the entire length of said brick, said upper face having a first recessed portion between said ridges, said first recessed portion ex-

tending substantially the entire length of said brick,

(v) each ridge being substantially triangular in form, having an outer surface which slopes steeply in a direction toward its adjacent side face and towards said bottom face to form, when one brick is placed atop another, an edge recess extending along each side of the join between adjacent said bricks, each ridge also having a narrow flat apex surface, and an inner surface which slopes steeply laterally inwardly toward said recessed portion,

(vi) said lower face having a pair of narrow flat edge surfaces one at each side of said brick and extending substantially the entire length of said brick, a pair of sloping surfaces sloping upwardly from said edge surfaces, and a flat re-

cessed surface joining said sloping surfaces to form a second recessed portion,said second recessed portion extending substantially the entire length of said brick,

(vii) said second recessed portion and said ridges being complementary in location so that when one brick is placed atop another, said sloping surfaces of said second recessed portion lie over said outer surfaces of said ridges to align said side faces of said bricks and to restrain sideways movement of one of said bricks relative to the other, and said flat recessed surface of said second recessed portion rests on said flat apex surfaces thereby carrying the weight of the upper brick, said flat recessed surface and said second recessed portion defining a horizontal space between said bricks,

(viii) said brick having an enlarged vertical hole extending between said upper and lower faces for an adhesive material to be poured therethrough, each end face having a pair of projecting vertical edge portions, one adjacent each edge of said brick and extending substantially the entire height of said brick, so that when two bricks are placed end to end, said edge portions lie sealingly against each other,

(ix) each end face of said brick having an enlarged end recess therein extending substantially the entire height of said end face, said end recess being substantially of the same width as that of said vertical hole and being substantially half the length of said vertical hole so that when two bricks are placed end to end, the two recesses in said

end faces are aligned and form a vertical opening of substantially the same dimensions as said vertical hole,

(x) the bricks being laid such that said central vertical holes and said vertical openings define vertical elongated holes,

(xi) said vertical hole being tapered vertically, and

(b) flowing an adhesive material into said vertical elongated holes.

Further objects and advantages of the invention will appear from the following description, taken together with the accompanying drawings in which:

Fig. 1 is an end view of a series of bricks according to the invention stacked one atop the other;

Fig. 2 is a top view of one of the bricks of Fig. 1;

Fig. 3 is a side view of a wall formed from bricks according to the invention and showing a tool according to the invention being used to apply mortar to the wall;

Fig. 4 is a perspective view of a modified tool according to the invention.

Fig. 5 is a side view of another embodiment of wall structure according to the invention.

Reference is first made to Figs. 1 and 2, which show building bricks 10 each having an upper major contact face 12, a lower major contact face 14, side faces 16 and 18, and end faces 20, 22. These faces are all substantially rectangular, except for the interlocking features to be described.

The upper face 12 has a pair of longitudinally extending engagement ridges 24 which extend the entire length of the brick, one at each side of the brick. Each ridge 24 is generally triangular in shape but has a narrow flat apex strip 25 extending along its top. Typical dimensions will be given shortly. The ridges 24 define between them a flat recessed horizontal area 26.

The lower face 14 has a pair of flat lower horizontal edge surfaces 28, one at each side of the brick and each also extending the entire length of the brick. Located between the edge surfaces 28 is a recessed surface 30 which is joined to the edge strips 28 by sloping surfaces 32. The sloping surfaces 32 slope at the same angle as the angle of the exterior sides of

the ridges 24.

As shown in Fig. 1, the ridges 24 and the recessed surface 30 with its sloping sides 32 are complementary. When one brick 10 is placed atop another, the ridges 24 of the lower brick engage within the sloping surfaces 32 of the upper brick. The surfaces 32 of the upper brick lie against the outer surfaces 34 of the ridges 24 and the flat depressed surface 28 rests on and is supported on the flat apex strips 25 at the tops of the ridges 24. This aligns the side faces of the bricks and prevents sideways movement of one brick relative to the other. In addition the forces exerted by one brick on another are substantially purely compressive.

It will be seen that the flat lower surface 28 of each upper brick does not protrude into the space between the ridges 24 of each lower brick. This allows the entire height of the space between the ridges 24 to be filled with mortar, facilitating automatic mortaring of a wall formed from the bricks as will be described.

In addition, it will be seen that each brick has at its bottom corner a downwardly protruding portion 36, defined by the sloping surface 32 and bottom edge strip 28. The downwardly protruding portion 36 helps to prevent precipitation from penetrating into the joint between the bricks. This helps to prevent

moisture from freezing within the joint and expanding, since such freezing and expanding action can tend to shear off the corners of the bricks.

It will also be seen that the vertical height of the outer surface 34 of ridge 24 is greater than that of the inner surface 38 of ridge 24. The relatively steep downward slope ensures adequate resistance against lateral movement of one brick relative to another and at the same time provides an adequate space 40 to provide the appearance of a mortar line. The space 40 may also be filled with mortar if desired.

As shown in Fig. 2, each end face 20, 22 is essentially flat, except for a pair of bevelled edges 42 which provide the appearance of a mortar line, and except for a recess 44 formed therein. The recess 44 as seen from above is formed in the shape of half of a square with rounded corners and extends between the upper and lower faces of the brick. The recess 44 is of the same width and half the length of a central vertical hole 46 located in the center of the brick and also extending between the upper and lower faces 12, 14. The central hole 46 is essentially square, with rounded corners, and like recess 44 is relatively large (typical dimensions will be given shortly). The vertical holes 46 can also be of any other shape in cross-section with the recesses 44 being formed in the

shape of half the cross-section of the holes 46.

Preferably both of the end recesses 44 and the central hole 46 are tapered from top to bottom, i.e. each recess and the hole 46 become narrower in cross-section in the direction from the top to the bottom of the brick. The walls of the recess 44 and the hole 46 taper inwardly essentially linearly and smoothly, as in a conic section, from the top to the bottom surface of the brick. The tapering is evident in Fig. 2 and is shown in exaggerated form in Fig. 3.

It is found that the tapering shown allows the bricks to be formed from concrete or clay materials under high pressure, typically 500 to 1,000 pounds per square inch or more, while facilitating removal of the brick from the mold. If the holes were not tapered, then lower mold pressures should be used to avoid damage to the brick during removal of the brick from the mold. Much more durable bricks can therefore be produced. In addition the tapering facilitates automatic mortaring, as will be described.

Preferred dimensions of a brick according to the invention are shown in Table 1 below:

TABLE 1

DIMENSION	SIZE (mm)
d1	111
d2	21

d3	10
d4	9
d5	31
d6	14
d7	7
d8	69
d9	80
d10	15.16
d11	9
d12	5
d13	10.16
d14	222
d15	42
d16	40
Angle A	54 1/2°
Angle B	45°
Angle C	54 1/2°

Reference is next made to Figs. 3 and 4, which show how a wall according to the invention may be formed and then automatically mortared. As indicated in Fig. 3, bricks 10 according to the invention are stacked one atop the other to form a wall 50. When the wall 50 is formed, the end recesses 44 of the bricks come together in opposing pairs to form vertical holes of the same size as the central holes 44. The holes formed by the end recesses 44 and the central holes 46

are thus aligned to form vertical elongated holes 52 which extend the entire height of the wall 50 as shown in Fig. 3. The vertical elongated holes 52 connect with the horizontal passages formed by the recesses 26 of each lower brick and the flat surface 30 at the bottom of each upper brick.

An adhesive filler material is poured down the vertical elongated holes 52 and flows into the horizontal connecting spaces defined between the stacked bricks. The adhesive filler material may be mortar or a synthetic resin for example.

In order to fill the spaces in the wall with adhesive filler material, a wand indicated at 56 in Figs. 3 and 4 may be used. The wand 56 comprises a number of vertical pipes 58 (two in number in Fig. 3 and three in number in Fig. 4) connected by a horizontal pipe 60 and having a hose 62 extending thereto. Adhesive filler material is pumped through the hose 62 into the horizontal connecting pipe 60 and flows down through the vertical pipes 58, which are inserted into the holes 52 in the wall. As the filler material fills the spaces within the bricks, the pressure of the filler material causes the wand 56 to rise, so that the operator need not actually pull the wand from the wall. Instead, because the wand will rise due to the pressure of the filler material,

the operator can simply guide the wand as it rises and can shut off the flow of filler material by a control (not shown) when the bottom ends of the pipes 58 rise to the upper surface of the wall.

Because the vertical pipes 58 of the wand are all of the same length, more uniform filling of the wall is achieved. If adhesive filler material were simply poured down a single vertical hole in the wall, such material can flow non-uniformly through the wall and create blockages which prevent uniform flow when filler material is poured down an adjacent vertical hole. When the wand 56 is used, adhesive filler material flows horizontally in both directions from the tips of the pipes 58 as indicated by arrows 64, thus ensuring that the horizontal areas between the pipes are fully and uniformly filled. Then, provided that the wand is inserted down adjacent vertical holes while the filler material is still soft, the filler material is delivered more uniformly to adjacent bricks than would be the case were such material simply poured down the open holes at the top of the wall.

It will be noted that although the holes 46 and recesses 44 preferably taper, the taper is sufficiently small to permit introduction of the pipes 58 of the wand into the holes 52. The pipes 58 are preferably of external diameter nearly equal to that of

the minimum width of the holes 46 and recesses 44, for maximum carrying capacity and to help ensure that the pressure of the adhesive filler material will cause the wand 56 to rise as the filler material flows into the wall. However some clearance must be allowed in case the bricks are slightly misaligned when laid. Preferably there is about 1/8 inch clearance between the pipe and the wall of each hole, i.e. about 1/4 inch difference in diameter between the pipe and the minimum hole size. The tapering of the holes produces localized areas which surround the pipes 58 more snugly than the remainder of the holes, improving the flow of mortar horizontally, and yet since the bulk of each hole fits the pipes 58 more freely, movement of the pipes in and out of the holes is facilitated.

It is found when the adhesive filler material is mortar, that in order to provide uniform mortaring of all of the spaces within the wall, without blowing mortar out the seals formed by the end faces of the bricks, it is highly desirable to use a plasticizer in the mortar. Such a plasticizer reduces the viscosity of the mortar, allowing it to flow more easily and allowing a lower pumping pressure to be used, so that the mortar is less likely to flow past the end faces of the bricks. It is found that with an appropriate plas-

ticizer and with appropriate pumping pressures, essentially all the spaces within the bricks with mortar can be filled, producing a completely integrated mortar and brick mass.

Among the plasticizers which may be used are the following:

1. The plasticizer sold under the trade mark Sterad 300, by Sternsons Limited of Brantford, Ontario, Canada. This plasticizer is provided in liquid form and may be used at a dosage of 1.5 litres per hundred kilograms of combined cement and lime (for cement-lime mortar).

2. The plasticizer sold under the trade mark Plastade, by the said Sternsons Limited. This plasticizer is also supplied as a liquid and is applied at the rate of 60 to 90 millilitres per 100 kilograms of combined cement and lime (for cement-lime mortar).

The pressure at which the mortar is pumped depends on the number of pipes 58 employed in the wand 56, on the amount of plasticizer employed, and on ambiant conditions such as the temperature. Typically a relatively small pump may be used, such as those sold by Robbins & Meyers, Inc. of Springfield, Ohio, U.S.A. under its trade mark "Moyno". These are open throat pumps, and typically a pump number 214 may be used, having an output of 2.02 gallons per 100 revolutions

and able to handle a maximum particle size of .3 inches. Such pumps will provide a pressure differential of up to 150 pounds per square inch, depending upon the horsepower used, but in practice a lower pressure will be used (depending on the height of the wall being mortared) and will be adjusted by the operator to avoid blowing mortar out of the joints between the end faces of the bricks.

Although the bricks of the invention will normally be formed of a cementitious material, they may if desired be formed of other materials appropriate for the application in question. In addition, while a cementitious mortar is preferred, other suitable adhesive filler materials may as indicated be used as mortar depending on the application. In fact, if desired a flexible resin material may be used as the mortar, particularly in earthquake zones, to reduce damage to the wall caused by vibration and other movement.

In addition, if desired hardware including brackets may be inserted between the bricks, and the bricks may be cut away or relieved in that area, to create shelving on the wall. The shelving can be adjustable if desired.

In addition, water pipes, electrical wiring and the like may be run through the vertical holes and

passages if desired.

Referring next to Fig. 4 there is shown another embodiment intended for use in interior applications (partitions or furniture for example). Vertical tie rods 54 are placed to extend through the vertical elongated holes 52 in the structure 50 after the adhesive material is poured down therein.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A building brick having:

(a) upper and lower faces,

(b) first and second end faces,

(c) first and second side faces,

(d) said upper face having a pair of parallel upstanding ridges one adjacent each side of said brick and each ridge extending substantially the entire length of said brick, said upper face having a first recessed portion between said ridges, said first recessed portion extending substantially the entire length of said brick,

(e) each ridge being substantially triangular in form, having an outer surface which slopes steeply in a direction toward its adjacent side face and towards said bottom face to form, when one brick is placed atop another, an edge recess extending along each side of the join between adjacent said bricks, each ridge also having a narrow flat apex surface, and an inner surface which slopes steeply laterally inwardly toward said recessed portion,

(f) said lower face having a pair of narrow flat edge surfaces one at each side of said brick and extending substantially the entire length of said brick, a pair of sloping surfaces sloping upwardly from said edge surfaces, and a flat recessed surface joining said sloping surfaces to form a second recessed portion, said second recessed portion extending substantially the entire length of said brick,

(g) said second recessed portion and said ridges being complementary in location so that when one brick is placed atop another, said sloping surfaces of said second recessed portion lie over said outer surfaces of said ridges to align said side faces of said bricks and to restrain sideways movement of one of said bricks relative to the other, and said flat recessed surface of said second recessed portion rests on said flat apex surfaces thereby carrying the weight of the upper brick, said flat recessed surface and said second recessed portion defining a horizontal space between said bricks,

(h) said brick having an enlarged vertical hole extending between said upper and lower faces, each end face having a pair of projecting vertical edge portions, one adjacent each edge of

said brick and extending substantially the entire height of said brick, so that when two bricks are placed end to end, said edge portions lie sealingly against each other,

(i) each end face of said brick having an enlarged end recess therein extending substantially the entire height of said end face, said end recess being substantially of the same width as that of said vertical hole and being substantially half the length of said vertical hole so that when two bricks are placed end to end, the two recesses in said end faces are aligned and form a vertical opening of substantially the same dimensions as said vertical hole,

(j) said vertical hole and said recessed portions are tapered vertically to facilitate removal of said brick from a mold.

2. A brick according to claim 1 wherein the width of each said hole and each said end recess is at least about two millimeters greater at one of said upper and lower faces than the other of said upper and lower faces.

3. A brick according to claim 2 wherein said hole and said end recesses are narrower at the lower face of said brick than at said upper face.

4. A building brick according to claim 1 or 3 wherein the vertical height of said outer surface of

each ridge is greater than the vertical height of said inner surface of each ridge.

5. A building brick according to claim 1 or 3 wherein the distance from the center of said hole to each end face is the same.

6. A wall formed from self aligning bricks according to claim 1 wherein vertical central holes and said vertical end recesses define vertical elongated holes uniformly spaced apart along the wall and the bricks define a plurality of horizontal spaces extending between each vertically adjacent pair of bricks, said horizontal spaces communicating with said vertical elongated holes, said vertical elongated holes and said horizontal spaces being filled with an adhesive material.

7. A wall according to claim 6, wherein the adhesive material is a mortar, said mortar having a plasticizer therein

8. A wall according to claim 6, further comprising tie rods extending vertically through the vertical elongated holes.

9. A method of building a wall comprising:

(a) stacking a plurality of bricks to form said wall, each brick comprising:

(i) upper and lower faces,

(ii) first and second end faces,

(iii) first and second side faces,

(iv) said upper face having a pair of parallel upstanding ridges one adjacent each side of said brick and each ridge extending substantially the entire length of said brick, said upper face having a first recessed portion between said ridges, said first recessed portion extending substantially the entire length of said brick,

(v) each ridge being substantially triangular in form, having an outer surface which slopes steeply in a direction toward its adjacent side face and towards said bottom face to form, when one brick is placed atop another, an edge recess extending along each side of the join between adjacent said bricks, each ridge also having a narrow flat apex surface, and an inner surface which slopes steeply laterally inwardly toward said recessed portion,

(vi) said lower face having a pair of narrow flat edge surfaces one at each side of said brick and extending substantially the entire length of said brick, a pair of sloping surfaces sloping upwardly from said edge surfaces, and a flat re-

cessed surface joining said sloping surfaces to form a second recessed portion, said second recessed portion extending substantially the entire length of said brick,

(vii) said second recessed portion and said ridges being complementary in location so that when one brick is placed atop another, said sloping surfaces of said second recessed portion lie over said outer surfaces of said ridges to align said side faces of said bricks and to restrain sideways movement of one of said bricks relative to the other, and said flat recessed surface of said second recessed portion rests on said flat apex surfaces thereby carrying the weight of the upper brick, said flat recessed surface and said second recessed portion defining a horizontal space between said bricks,

(viii) said brick having an enlarged vertical hole extending between said upper and lower faces for an adhesive material to be poured therethrough, each end face having a pair of projecting vertical edge portions, one adjacent each edge of

said brick and extending substantially the entire height of said brick, so that when two bricks are placed end to end, said edge portions lie sealingly against each other,

(ix) each end face of said brick having an enlarged end recess therein extending substantially the entire height of said end face, said end recess being substantially of the same width as that of said vertical hole and being substantially half the length of said vertical hole so that when two bricks are placed end to end, the two recesses in said end faces are aligned and form a vertical opening of substantially the same dimensions as said vertical hole,

(x) the bricks being laid such that said central vertical holes and said vertical openings define vertical elongated holes,

(xi) said vertical hole being tapered vertically, and

(b) flowing an adhesive material into said vertical elongated holes.

10. A method according to claim 9 wherein vertical tie rods are placed to extend through said vertical elongated holes.

11. A method according to claim 9, wherein the adhesive material is a mortar, said mortar having a plasticizer therein to reduce the viscosity of said mortar so that said mortar may fill said holes and openings and said horizontal spaces, said mortar being pumped at a low enough pressure to prevent said mortar from leaking substantially past the abutting end faces of adjacent bricks.

12. A method according to claim 9 wherein said adhesive material ~~mortar~~ is flowed down a plurality of adjacent holes and openings simulataneously.

13. A method according to claim 9 wherein the distance from the center of said hole to each end face is the same and said step of flowing is performed using a wand having a plurality of vertical pipes having their centers spaced apart by said distance, said pipes being of outer diameter sized to permit said pipes to be inserted vertically into said holes and openings, and a support connecting said pipes at their upper ends, and conduit means for directing conduit into all of said pipes simultaneously.

14. A method according to claim 13 wherein there are two said vertical pipes.

15. A method according to claim 13 wherein there are three said vertical pipes.

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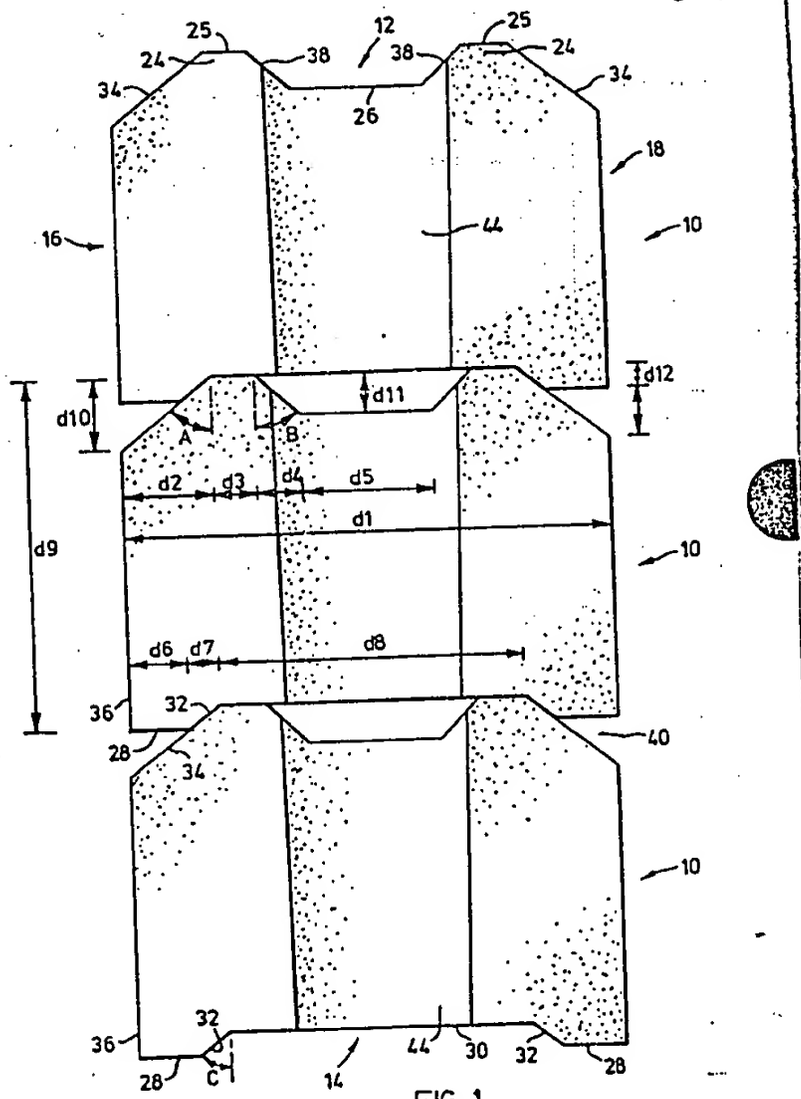

FIG. 1

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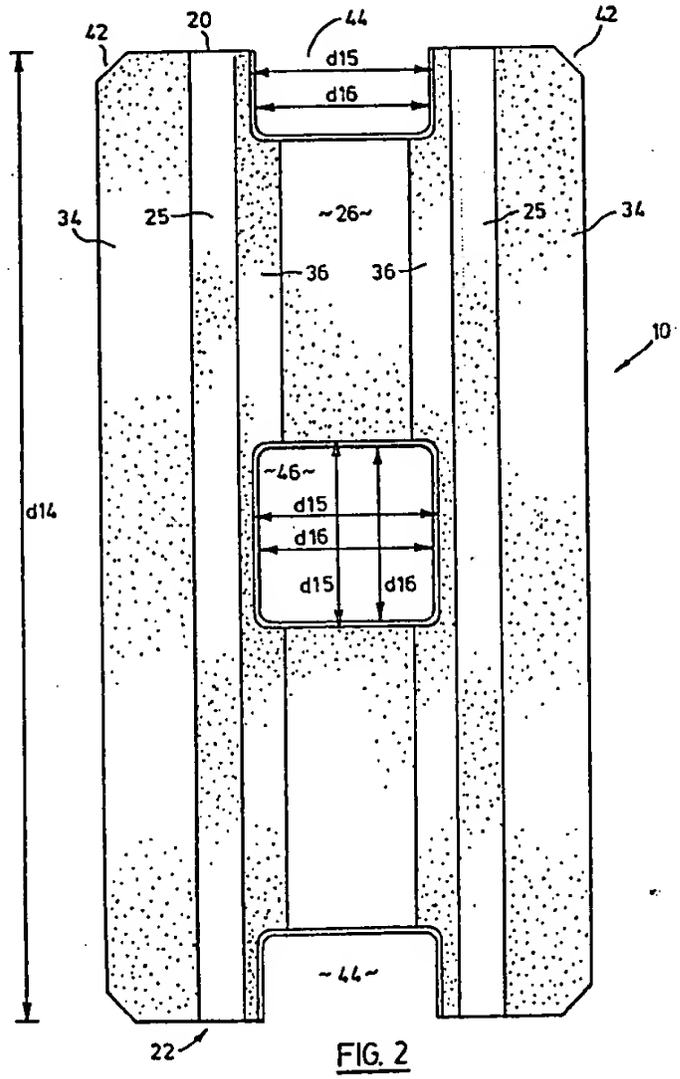

FIG. 2

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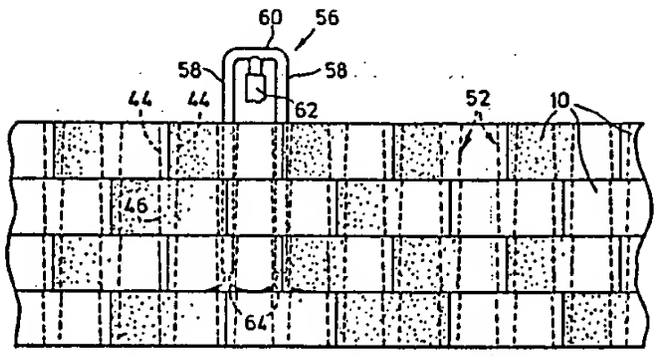

FIG. 3

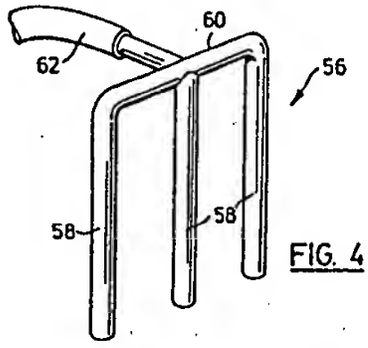

FIG. 4

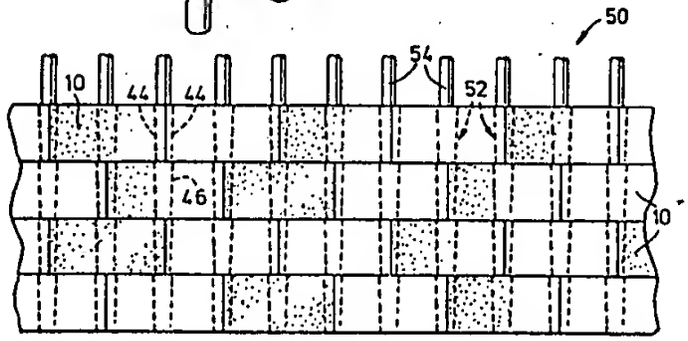

FIG. 5

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